

## ANNEX E

### HEAT WAVE

#### I. TYPE OF HAZARD

Heat Wave

#### II. DESCRIPTION OF HAZARD

A heat wave is a period of excessive heat, which can lead to illness and other stress to people with prolonged exposure to these conditions. High humidity, which often accompanies heat in Missouri, can make the effects of heat even more harmful. While heat-related illness and death can occur from exposure to intense heat in just one afternoon, heat stress on the body has a cumulative effect. Consequently, the persistence of a heat wave increases the threat to public health. The National Weather Service (NWS) defines a heat wave as three consecutive days of temperatures of 90 degrees Fahrenheit (°F) and above. These high temperatures generally occur from June through September, but are most prevalent in the months of July and August. Missouri experiences about 40 days per year above 90 °F, based on a 30-year average compiled by the NWS from 1961 through 1990. July leads this statewide mean with 15 days above 90 °F, followed by August with an average of 12 days over 90 F. June and September average 6 days and 4 days, respectively, for temperatures above 90 °F. The 30-year climatic data is from NWS stations at Kansas City, Columbia, Springfield, and St. Louis. As these regional locations indicate, all of Missouri is subject to heat wave during the summer months.

Along with humans, animals also can be affected by high temperatures and humidity. For instance, cattle and other farm animals respond to heat by reducing feed intake, increasing their respiration rate, and increasing their body temperature. These responses assist the animal in cooling itself, but this is usually not sufficient. The hotter the animal is, the more it will begin to shut down body processes not vital to its survival, such as milk production, reproduction, or muscle (meat) building.

Ambient temperature is not the only factor that should be considered when assessing the likely effects of heat. Relative humidity must also be considered, along with duration of exposure, wind, and activity. The NWS has stepped up its efforts to more effectively alert the general public and appropriate authorities to the hazards of heat waves—those prolonged episodes of excessive heat and humidity. The NWS has devised a Heat Index (HI), which is a combination of air temperature and relative humidity, and more accurately reflects the heat intensity.

The HI, given in degrees Fahrenheit, is an accurate measure of how hot it really feels when the relative humidity (RH) is added to the actual air temperature. The Heat Index Chart is shown on Figure E-1. As an example, if the air temperature is 96 °F (found on the left side of the table), and the relative humidity is 55% (found at the top of the table), the HI is 112 °F (the intersection of the 96° row and the 55% column). Because HI values were devised for shady, light wind conditions, exposure to full sunshine can increase HI values by up to 15 °F. Also, strong winds, particularly with very hot, dry air, can be extremely hazardous.

**FIGURE E-1**

Temperature (F) versus Relative Humidity (%)									
°F	90%	80%	70%	60%	50%	40%	30%	20%	10%
65	65.6	64.7	63.8	62.8	61.9	60.9	60.	59.1	58.1
70	71.6	70.7	69.8	68.8	67.9	66.9	66.	65.1	64.1
75	79.7	76.7	75.8	74.8	73.9	72.9	72.	71.1	70.1
80	88.2	85.9	84.2	82.8	81.6	80.4	79.	77.4	76.1
85	101.4	97.	93.3	90.3	87.7	85.5	83.5	81.6	79.6
90	119.3	112	105.8	100.5	96.1	92.3	89.2	86.5	84.2
95	141.8	131.1	121.7	113.6	106.7	100.9	96.1	92.2	89.2
100	168.7	154.	140.9	129.5	119.6	111.2	104.2	98.7	94.4
105	200	180.7	163.4	148.1	134.7	123.2	113.6	105.8	100.
110	235.	211.2	189.1	169.4	151.9	136.8	124.1	113.7	105.8
115	275.3	245.4	218	193.3	171.3	152.1	135.8	122.3	111.9
120	319.1	283.1	250.	219.9	192.9	169.1	148.7	131.6	118.2

Risk Level	Possible Heat Disorder:
Caution	Fatigue possible with prolonged exposure and physical activity.
Extreme Caution	Sunstroke, heat cramps and heat exhaustion possible.
Danger	Sunstroke, heat cramps, and heat exhaustion likely, and heat stroke possible.
Extreme Danger	Heat stroke highly likely with continued exposure.

\*Note: On the HI chart, the shaded zone above 105 °F corresponds to a level that may cause increasingly severe heat disorders with continued exposure or physical activity.

Heat waves are often a major contributing factor to power outages (brownouts, etc.), as the high temperatures result in a tremendous demand for electricity for cooling purposes. Power outages for prolonged periods increase the risk of heat stroke and subsequent fatalities due to loss of cooling and proper ventilation.

Other related hazards include water shortages brought on by drought-like conditions and high demand. Local advisories, which list priorities for water use and rationing, are common during heat waves. Government authorities report that civil disturbances and riots are also more likely to occur during heat waves, as well as incidents of domestic violence and abuse.

### III. HISTORICAL STATISTICS

Heat kills by taxing the human body beyond its abilities. In a normal year, approximately 175 Americans succumb to summer heat. In a 40-year period, 1936 through 1975, nearly 20,000 people died in the United States from the effects of heat and solar radiation. Over the past nine decades, the Missouri State Department of Health has compiled statistics for deaths from excessive heat. Figure E-2 in Section VII depicts the number of deaths in Missouri from 1911 to 2000. In 2001, it was reported that 47 Missourians died due to heat-related causes. In 2002, 24 persons died in Missouri due to heat. In United States, some

of the worst years for heat-related deaths occurred during the Great Depression, with 843 deaths in 1934, and 644 in 1936. The worst year in the past few decades was 1980, with 1,250 deaths from excessive heat.

#### IV. MEASURE OF PROBABILITY AND SEVERITY

Based on 30-year statistics from the NWS indicating the state's mean number of days above 90 °F, Missouri is vulnerable to heat waves ranging from high to moderate risk in July and August. The NWS has developed a Heat Index/Heat Disorder Chart that relates ranges of HI with specific disorders, particularly for people in higher risk groups (Table E-1).

**TABLE E-1**

<b>Heat Index</b>	<b>Heat Disorder</b>
130 °F or higher	Heat stroke or sunstroke likely with continued exposure
105 to 129 °F	Sunstroke, heat cramps, or heat exhaustion likely, and heat stroke possible with prolonged exposure or physical activity
90 to 104 °F	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure or physical activity
80 to 89 °F	Fatigue possible with prolonged exposure or physical activity

Table E-2 shows the three response levels developed by the NWS, based on the Heat Index, to alert the public to the potential heat hazards:

**TABLE E-2**

<b>Heat Index</b>	<b>Response Level</b>
130 °F or higher	Warning
105 to 129 °F	Watch
90 to 104 °F	Advisory

Based on information from the Department of Health and Senior Services and the NWS, the State rates the probability of a heat wave as moderate and severity as moderate, but the probability could be upgraded to severe.

The Missouri Department of Health and Senior Services will announce a statewide hot weather health alert (Table E-3), when the conditions are as follows:

**TABLE E-3**

<b>Type of Alert</b>	<b>Conditions of Alert</b>
Hot Weather Health Alert	Heat indices of 105 °F in a large portion of the state are first reached (or predicted).
Hot Weather Health Warning	Heat indices have been 105 °F or more for 2 days in a large portion of the state; or weather forecasts call for continued heat stress conditions for at least 24 to 48 hours, over a large portion of the state.
Hot Weather Health Emergency	When extensive areas of the state meet the following criteria: (1) High sustained level of heat stress (HI 105 °F for 3 days), (2) Increased numbers of heat-related illnesses and deaths statewide, and (3) The NWS predicts hot, humid temperatures for the next several days for a large portion of the state.

#### V. IMPACT OF THE HAZARD

The severity of heat disorders tends to increase with age. Heat cramps in a 17-year-old can become heat exhaustion for someone in their forties, and may result in a fatal stroke for someone in their sixties. The following table lists conditions associated with heat, their symptoms and suggested first aid.

**TABLE E-4**

<b>Heat Disorder</b>	<b>Symptoms</b>	<b>First Aid</b>
Sunburn	Redness and pain. In severe cases, swelling of skin, blisters, fever, and headaches.	Apply ointment for mild cases if blisters appear. If breaking occurs, apply dry sterile dressing. Serious, extensive cases should be seen by physician.
Heat Cramps	Painful spasms possible usually in muscles of legs and abdomen. Heavy sweating.	Apply firm pressure on cramping muscles, or gentle massage to relieve spasms. Give sips of water.
Heat Exhaustion	Heavy sweating and weakness; cold, pale and clammy skin. Pulse thready. Normal temperature possible. Fainting and vomiting.	Get victim out of sun. Lie down and loosen clothing. Apply cool wet cloths. Fan or move victim to air conditioned room. Give sips of water. If vomiting continues, seek immediate medical attention.

Heat Disorder	Symptoms	First Aid
Heat Stroke (or Sunstroke)	High body temperature (106 °F, or higher). Hot dry skin. Rapid and strong pulse. Possible unconsciousness.	Heat stroke is a severe medical emergency. Summon medical assistance or get the victim to a hospital immediately. Delay can be fatal. Move the victim to cooler environment. Reduce body temperature with cold bath or sponging. Use extreme caution. Remove clothing. Use fans and air conditioners. If temperature rises again, repeat process. Do not give fluids.

The following population groups are at a greater risk to becoming very sick from heat waves:

- A. Those Vulnerable To Heat Stress Due To Physical Condition
  - 1. Older people
  - 2. Children
  - 3. People overweight or underweight.
- B. People With Limited Independence Due To Physical or Mental Disorders
  - 1. People in institutional settings without air conditioning
  - 2. People working in heat under stress (firefighters, police, emergency medical technicians)
  - 3. People in urban environments where heat retention in asphalt, concrete and masonry is a factor (heat island effect)
  - 4. People with low income who lack resources for air conditioning, transportation, medical care, etc.
- C. Those With Increased Risk From Work or Leisure Activities
  - 1. People who work outdoors (utility crews, construction crews, etc.)
  - 2. Military personnel and trainees
  - 3. Athletes.
- D. Those More Difficult To Reach Through Normal Communications
  - 1. People who live alone
  - 2. People who are homeless
  - 3. People who do not speak English
  - 4. People who cannot read
  - 5. People who are culturally, socially, or geographically isolated.

Even when a heat injury isn't fatal, it can be extremely serious and require lifelong monitoring of further exposure to heat. Besides mortality statistics due to heat, the Missouri Department of Health and Senior Services tracks heat-related injuries. Figure E-3 in Section VII shows heat-related illnesses in Missouri from 1991 through 2000.

As previously mentioned, animals can be adversely affected by heat stress. This poses a risk to farmers, ranchers, and the entire State of Missouri, which relies on agricultural revenue to keep the economy strong. Livestock producers cannot afford to ignore the effects of high temperatures on their herds. The following symptoms are signs of heat stress on livestock:

- Restlessness and crowding under shade or at water tanks/areas
- Open-mouthed breathing or panting and increased salivating
- Increased respiration rates
- Gasping and lethargic demeanor.

## VI. SYNOPSIS

Many people do not realize how deadly a heat wave can be. In contrast to the visible, destructive, and violent nature of floods, hurricanes, and tornadoes, a heat wave is a "silent killer." Be aware of the warning signs of heat-related illness, such as light-headedness, mild nausea or confusion, sleepiness, or profuse sweating. To prevent heat-related illness, take the following precautions:

- Increase your fluid intake; drink more liquids than your thirst indicates.
- Drink nonalcoholic and caffeine-free liquids, such as water and juices.
- Wear lightweight, light colored, loose-fitting clothing.
- When unaccustomed to working or exercising in a hot environment, start slowly and pick up the pace gradually; rest frequently in a shady area.
- Spend time in an air-conditioned place; if not at home, then spend time in such public places as libraries, supermarkets, shopping malls, and movie theatres.
- Do not rely on fans as your primary cooling devices during a heat wave.
- Schedule outdoor activities carefully, preferably before noon or in the evening.
- When working in the heat, monitor the condition of your co-workers and have someone do the same for you.
- Monitor those at high risk, such as the elderly, infants, and children up to 4 years of age, someone who is overweight, or someone on medication.

- Ask your physician whether you are at particular risk because of medication.
- Do not leave infants, children, or pets unattended in a parked car or other hot environments.

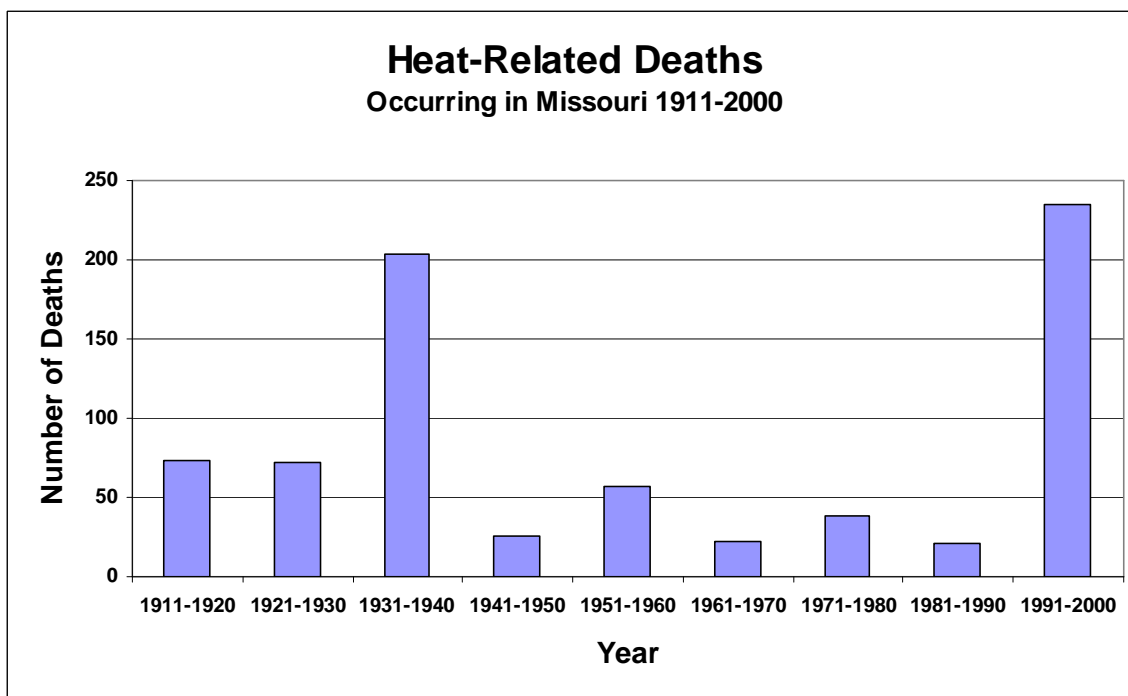
Although fans are less inexpensive to operate, they may not be effective, and may even be harmful when temperatures are very high. As the air temperature rises, airflow is increasingly ineffective in cooling the body until finally, at temperatures above 100 °F (the exact number varies with the humidity), increasing air movement actually increases heat stress. More specifically, when the temperature of the air rises to about 100 °F, the fan may be delivering overheated air to the skin at a rate that exceeds the capacity of the body to get rid of this heat, even with sweating, and the net effect is to add heat rather than to cool the body. An air conditioner, if one is available, is a much better alternative. More information on heat-related illness is available through the Department of Health's web page at [www.health.state.mo.us/ColdAndHeat/CandH.html](http://www.health.state.mo.us/ColdAndHeat/CandH.html).

## VII. MAPS OR OTHER ATTACHMENTS

Attached are the Missouri Department of Health statistics for heat-related illnesses and deaths.

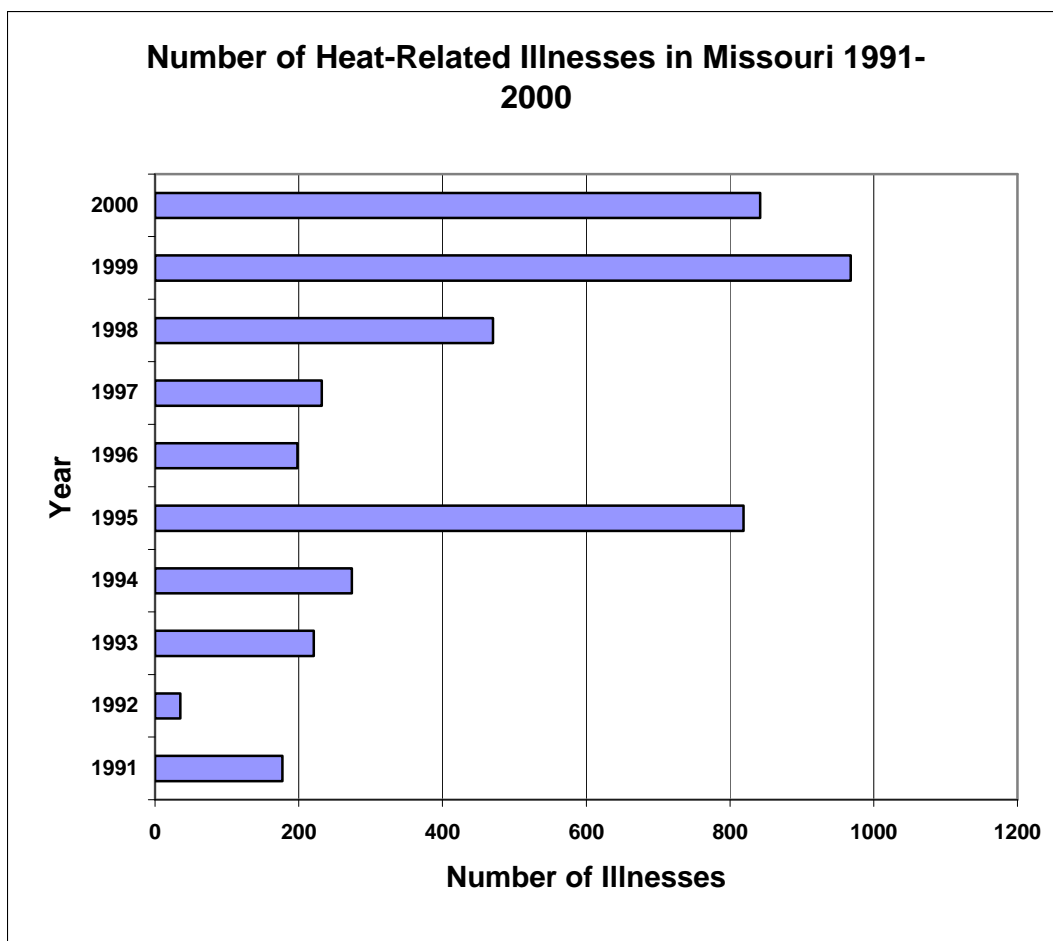
- Heat-Related Death Chart: Figure E-2
- Number of Heat-Related Illnesses in Missouri in 1991-2000: Figure E-3.

**FIGURE E-2**





**FIGURE E-3**



## VIII. BIBLIOGRAPHY

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